Space Weather Technical Forecast

Issued on Monday, 25 July 2022 at 13:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of Active electron fluence. Slight Chance of R1/R2 throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low during the last 24 hours, with only one C1 flare observed at 25/0832 UTC and emanating from a region behind the northeast limb. There are seven numbered sunspot regions on the visible disc, most of which are relatively simple and fairly inactive. There has been numerous faint CMEs seen in Coronagraph imagery in the past 24 hours but none of these are considered to be Earth-directed. A filament eruption occurred at 24/1837UTC in the southeast quadrant, near AR3062, although there is currently no evidence of a CME in available imagery. No Earth-directed CME's have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was characteristic of the tail end of a coronal hole high speed stream. The solar wind speed decreased from 530 to 430km/s. Density was largely average but displayed a steady declining trend towards below average levels, ending the period at around 3ppcc. The magnetic field strength was steady and weak, at around 5nT, while the north-south component (Bz) remained weak, varying between -4nT and +4nT. The phi angle was largely negative (towards the Sun).The net result of the above solar wind measures was for mostly Quiet conditions, with an provisional Unsettled (Kp3) observed in the 00-03UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16 was at Background levels.

High energy electron flux (greater than 2MeV) varied between Moderate and Normal Background levels, with a peak of around 927pfu observed around 24/1815UTC. Electron fluence displayed a steady increasing trend but remained well below the Active threshold. An observed fluence of 2.59e7 integrated pfu was recorded at 25/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is likely to remain Low with only a Slight Chance of M-class flares. Barring development, three further regions should leave the Earth-facing side of the Sun in the period, however the eastern solar hemisphere's far side is congested with the expected returning sunspot locations, such that activity ought to be maintained, pending proper analysis of any arrivals.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently forecast. Solar winds are expected to slowly decline towards slow-ambient levels, with no significant enhancements expected during this period. Geomagnetic activity is therefore expected to remain predominantly Quiet with isolated Unsettled intervals.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is

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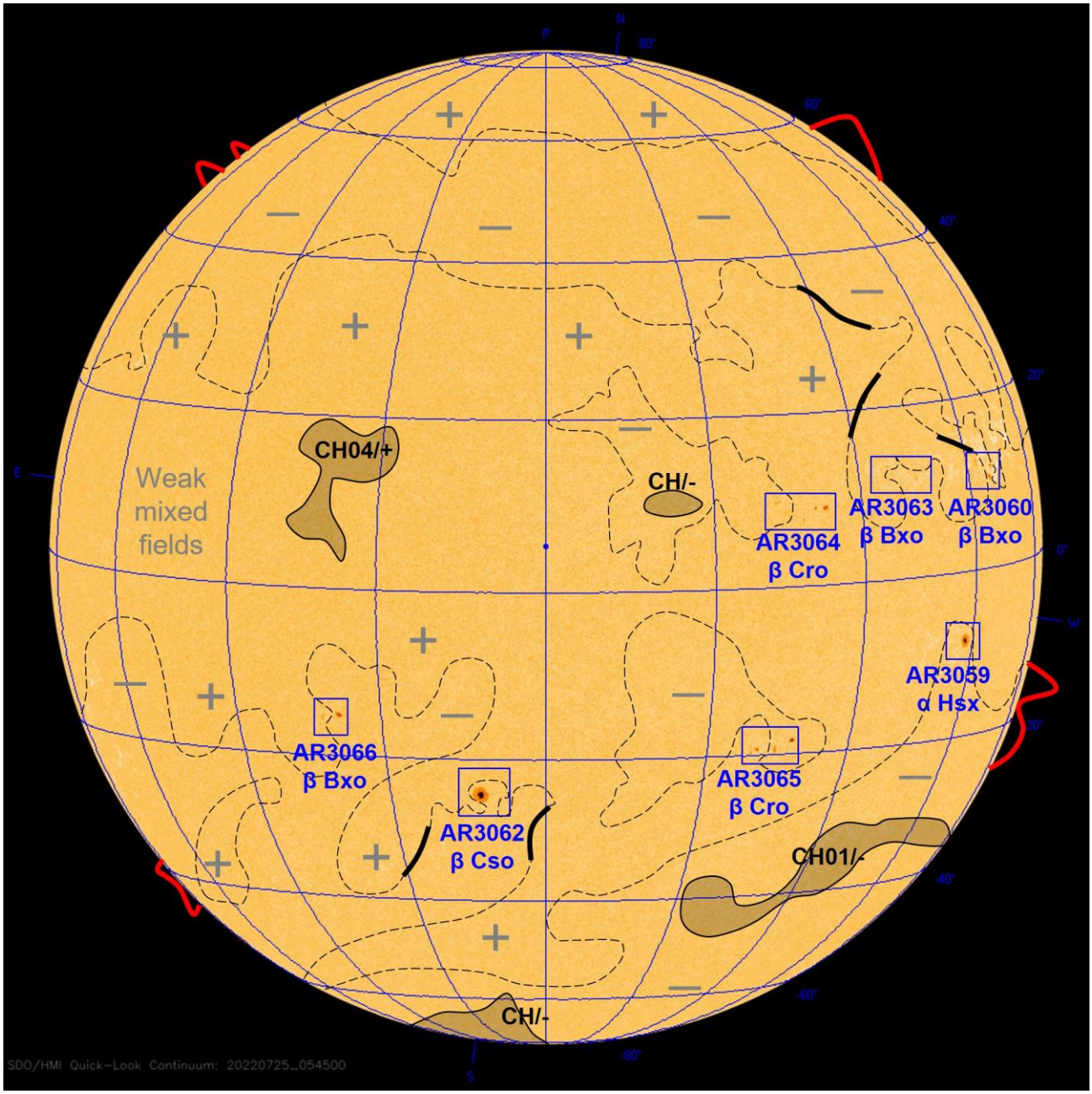
expected to remain at Background levels.
The high energy electron flux (greater than 2 MeV) is expected to vary between Background and Moderate levels initially, with an increasing risk of exceeding the high (1e3 pfu) threshold over the following days. The rationale for this is waning geomagnetic activity and the realisation of the current high speed stream effects. Electron fluence is forecast to follow an increasing trend through the period before plateauing, with a Chance of exceeding the Active (1e8 integrated pfu) level, most likely on day 3 (27th) and day 4 (28th).

Figure 1. Solar Analysis Valid 25/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:
There has been numerous faint CMEs seen in Coronagraph imagery in the past 24 hours but none of these are considered to be Earth-directed. A filament eruption occurred at 24/1837UTC in the southeast quadrant, near AR3062, although there is currently no evidence of a CME in available imagery. No Earth-directed CME's are currently forecast.

The 21 July CME's effects are now considered to have passed, with a resumption of the earlier fast wind from a pair of negative polarity high speed streams, one of which is still visible on the SDO/AIA 211 channel. STEREO A MAG and PLASTIC data suggests that this fast wind ought to be in decline into the new working week UTC, such that by Day 1 (25 July) Quiet conditions ought to be predominant.

A small unnumbered feature has recently appeared near the solar equator. It is currently transiting across the western hemisphere but the associated high speed stream should only have a limited impact on the solar wind at Earth.

Geomagnetic activity is therefore expected to remain predominantly Quiet with isolated Unsettled intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections
NIL.

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Radio Blackouts - X-Ray Flares:
Solar activity has been Low during the last 24 hours, with only one C1 flare observed at 25/0832 UTC and emanating from a region behind the northeast limb.

There are seven numbered sunspot regions on the visible disc, most of which are relatively simple and fairly inactive. AR3062 is showing signs of growth, with spots tentatively developing on its leading edge. The most recent region, AR3066, is also growing, still a simple bipolar but one of its spots may develop a penumbra. All the other regions are largely unchanged or slightly weakening, particularly those approaching the western limb.

Activity is likely to remain Low with only a Slight Chance of M-class flares. Barring development, three further regions should leave the Earth-facing disc in the period, however the eastern hemisphere far side is congested with the expected returning Carrington locations of numerous regions in the four days, such that activity ought to be maintained, pending proper analysis of any arrivals.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 2: Far-side sounding, which shows conjection of possible active regions directly on the far-side of the Sun. This may be a glimpse of the possible size and scale of upcoming eastern solar horizon arrivals during the forecast period.

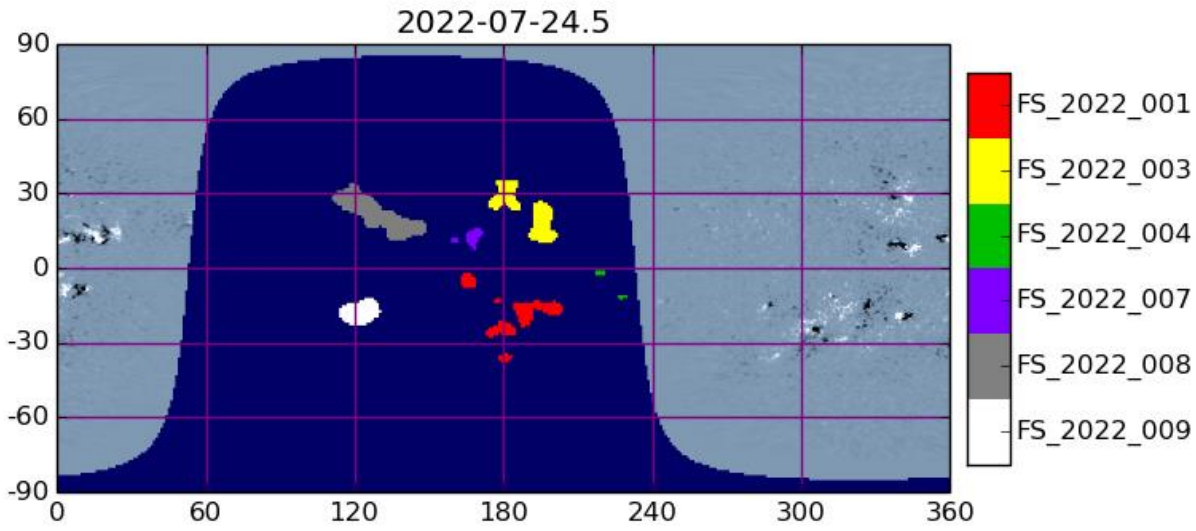

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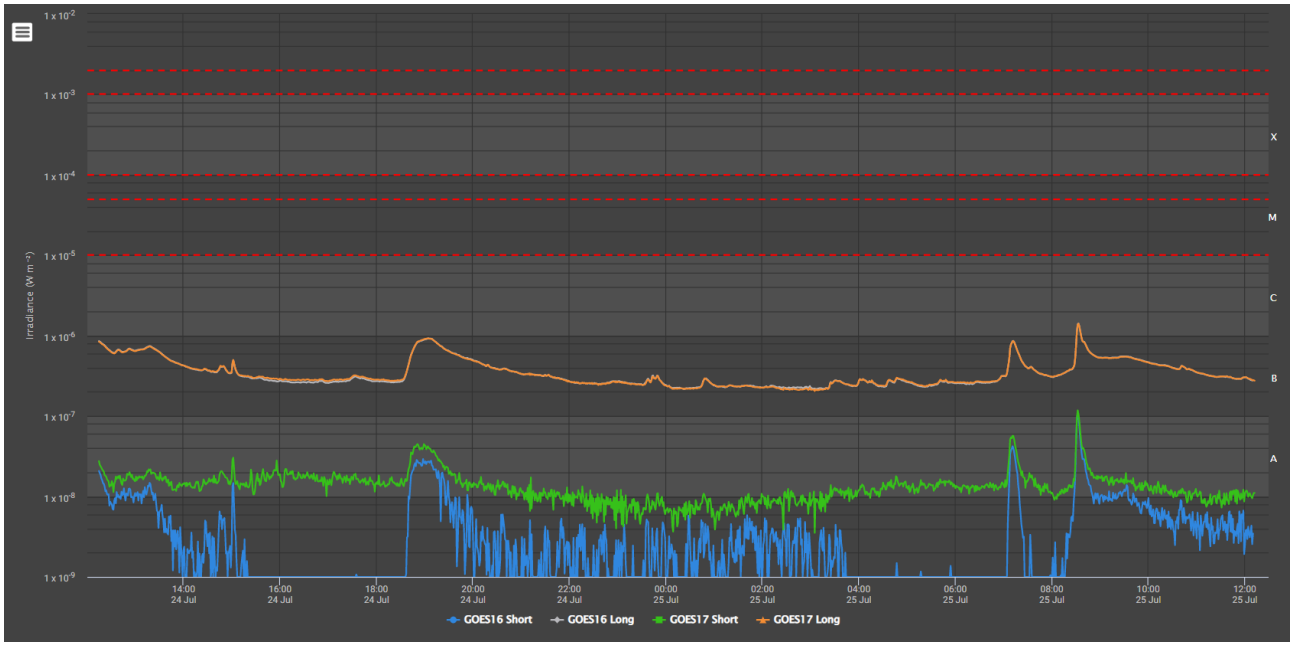
Figure 3: Latest GOES X-ray flare activity



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels. As most regions are small and relatively magnetically simple, the risk of a proton enhancement is very low.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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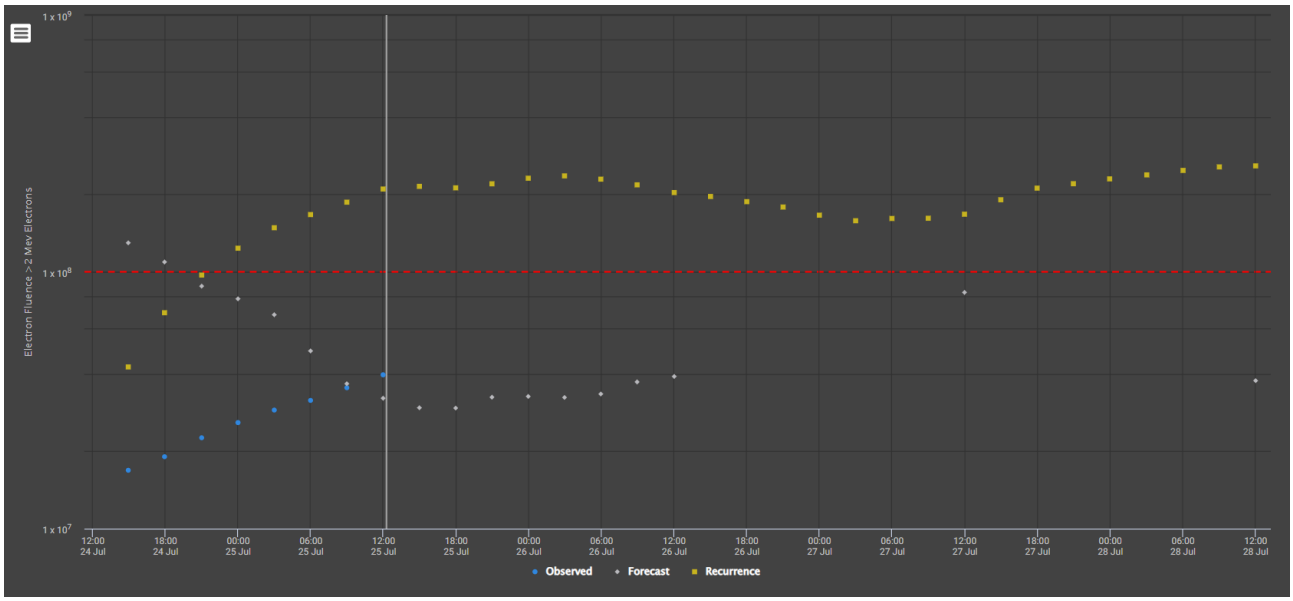
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is expected to respond with an increasing amplitude oscillation in the coming 24 hours, probably in a manner roughly akin to the past rotation. The rationale for this is that the fast wind from the current persistent coronal hole(s) CH01/02 appears to have out-lasted the 21 July CME's effects to continue to charge the Van Allen belts to some degree.

The risk of 24-hour integrated fluence breaching Active is therefore upwards, probably finding its level at the start of this period before stabilising.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	30	40	50	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: Latest REFM output



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